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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER	
JOHNSTON, PHILLIP A	
ART UNIT	**PAPER NUMBER**
2881	

DATE MAILED: 12/17/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/017,262	ADLER ET AL.	
	Examiner	Art Unit	
	Phillip A Johnston	2881	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *21 October 2003*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *48-56,61,62 and 66-69* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *48-56,61,62 and 66-69* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *14 December 2001* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. §§ 119 and 120

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

13)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application) since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

a) ☐ The translation of the foreign language provisional application has been received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121 since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____.
4) ☐ Interview Summary (PTO-413) Paper No(s). _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

Detailed Action

1. This Office Action is submitted in response to RCE / Amendment dated 10-21-2003, wherein Claims 9-15, 36-47 and 57 are cancelled. Claims 1-8,16-35,58-60, and 63-65 were previously cancelled. Claims 48-56,61-62, and 66-69 remain in the application. Claims 48,55,61,66, and 69 are amended, and no new Claims have been added .

Claims Rejection – 35 U.S.C. 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which the subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

3. Claims 48-56,61-62, and 66-69 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 6,465,781 to Nishimura, in view of Larson U.S. Patent No. 5,444,242, and in further view of Ose, U.S. Patent Pub. No. 2001/0010357.

Nishimura (781) discloses in FIG. 1 an electron beam apparatus 10 that includes in the vacuum interior of a barrel 2 an electron beam source 11 having an electron gun

which emits an electron beam, a condenser lens and a drawing electrode, a blanking mechanism 17 which turns on and off the projection of electron beam, a deflecting device 12 which deflects the electron beam, an electromagnetic lens 13 which focuses the electron beam on a sample 16, and an electron detector 14 for detecting electrons, e.g., secondary electrons or reflected electrons released from the sample 16, and further includes inside a vacuum chamber 3 an x/y table 15 on which is mounted a sample stage 21 for placing the sample 16, a position measuring device (not shown) for measuring the position of the x/y table 15 accurately, a grid electrode 24 disposed near the sample 16, and a height measuring device 19 for measuring the height of the sample 16.

The barrel 2 of the electron beam apparatus 10 further incorporates a UV light projection system 30 which projects a UV light into the barrel 2 for the purpose of preventing the contamination and charge-up of the barrel interior, and a UV light source 31 which irradiates the sample 16 with a UV light during the scanning of the electron beam thereby to discharge the sample 16 (to maintain surface charge, as recited in Claims 48,55,61,66, and 69).

The UV light source 31 can be an excimer lamp which is designed to irradiate the insulation film on the sample 16 of semiconductor substrate or the like with a UV light of 150 nm or less thereby to energize electrons in the valence band (filled band) in the insulation film to shift to the conduction band so that the electrons contribute to the electrical conduction (electronic conduction), thereby causing charges on the insulation film to flow out to the sample stage 21 having the application of a negative

voltage (again, to maintain surface charge, as recited in Claims 48,55,61, 66, and 69). See Column 5, line 29-67; and Column 6, line 1-15.

Nishimura (781) also discloses a beam source potential adjusting device 9 adjusts the potential of the electron beam source 11 in accordance with the potential adjusting command from the general controller 8. A grid potential adjusting device 25 adjusts the potential of the grid electrode 24, which is virtually the ground voltage, in accordance with the potential adjusting command from the general controller 8. A sample stage potential adjusting device 22 adjusts the negative potential of the sample stage 21 in accordance with the potential adjusting command from the general controller 8. These beam source potential adjusting device 9, grid potential adjusting device 25 and sample stage potential adjusting device 22 adjust the potential of the electron beam source 11, grid electrode 24 and sample stage 21, respectively, so that the electron beam detecting condition varies, thereby controlling the image quality, such as the contrast, of the produced image.

A stage controller 23 controls the movement of the x/y table 15 based on the positional feedback in accordance with the command from the general controller 8. The electron beam emitted by the electron beam source 11 is converged by the condenser lens (not shown) in the electron beam source 11 and the electromagnetic lens (objective lens) 13 to have a beam diameter comparable with the pixel size on the sample surface and projected in the focused state to the sample surface. At this time, a negative voltage is applied to the sample 16 through the sample stage 21, with the grid electrode 24 being kept at virtually the ground voltage, so that the electron beam

is decelerated on the path between the objective lens 13 and the sample 16, thereby enhancing the resolution of image in the low acceleration voltage range (having sufficiently low energy as recited in Claims 48,55,61, 66, and 69). See Column 6, line 49-67; and Column 7, line 1-12.

Nishimura (781) further discloses that in the case of the dimensional measurement based on electron beam imaging, for example, for an electron image 120 exhibiting a line width W1 shown in FIG. 12 produced in the absence of charge-up, the occurrence of charge-up causes the electron detector 14 to produce an electron image which exhibits a swelled line width W2 as shown in FIG. 13, resulting in a measurement result of an erroneously larger line width W2. In FIG. 12A, FIG. 12B shown by (a) is the electron image 120 in the absence of charge-up, and (b) is the measured line width W1 on the scanning line "a". Similarly, shown by FIG. 13B is the line width W2 on the scanning line "a", which is measured larger erroneously due to charge-up. Different magnification factors at positions due to charge-up, exhibits different line widths W3 and W4, which are actually the same, as shown in FIG. 14.

For coping with this matter, the UV light source 31 is activated to emit an exciting UV light of 150 nm or less to the sample 16, e.g., a semiconductor substrate, so as to cover the observation field of electron beam scanning. In the insulation film of SiO_2 or Si_3N_4 on the sample 16, electrons in the valence band (filled band) are energized to shift to the conduction band so that the electrons contribute to the electrical conduction

(electronic conduction), thereby causing charges on the insulation film to flow out to the sample stage 21 having the application of a negative voltage, and the sample 16 is discharged. See Column 14, line 45-67; and Column 15, line 1-3.

Nishimura (781) still further discloses that, the irradiation of UV light 39 of 150 nm or less to the above-mentioned insulation films will create photoelectrons, which will be detected as a noise component by the electron detector 14. On this account, a UV irradiation controller 32 is used so that the UV light 39 (39'), which irradiates the same view field as of the electron beam, does not interfere with the electron beam. Specifically, the UV irradiation controller 32 receives the horizontal scanning signal 151 (particularly the blanking signal included in it) from the scanning controller 18 thereby to produce a UV light irradiation signal 152 as shown in FIG. 15. The signal 152 is used to activate the UV light source 31 during the blanking period or open the shutter means (e.g., a swing mirror) 38 on the UV light path during the blanking period, (the alternately exposed influx of photons and electrons, as recited in Claim 50). See Column 15, line 26-39.

Also, in regard to the UV light source 31, if it necessitates pumping at an interval of 10-50 mμs, for example, and has its emitted UV light intensity varying periodically, as in the case of an A.C. excimer lamp for example, the scanning controller 18 is designed to quit blanking and project the scanning electron beam across the inspection/measurement area on the sample 16 during the period Te of lower UV emission of the UV light source 31 as shown in FIG. 20 informed by the general controller 8 or irradiation controller 23, and operate on the electron detector 14 to

produce an electron image in this period, whereby it is possible to produce an electron image which is rid of the influence of photoelectrons created by the UV light irradiation and relieved of charge-up (the concurrently exposed influx of photons and electrons, as recited in Claim 49). See Column 17, line 5-18.

Although Nishimura (781) exposes the substrate to both low–energy electrons and photons to maintain surface charge on the substrate at a predetermined level, Nishimura (781) does not specifically disclose the selection of both an energy and current density profile of the low-energy electrons to maintain surface charge on the substrate. Larson (242); however, discloses an instrument 10 for analysis of a surface 12 of a sample specimen 14,illustrated schematically in FIG. 1. An electron gun 16 has an appropriate electron lens system 18 for focusing an electron beam 20 onto the surface 22 of a target anode 24. The gun may be a conventional type, modified to optimize for higher power and larger beam size. The electron beam 20 should focus to a spot 26 (FIG. 3) on the anode surface, the spot being as small as practical, e.g. down to about 4 microns. This results in the generation of x-rays 27 from the anode, and in particular from the anode spot.

A Bragg crystal monochromator 34, advantageously single-crystal quartz, is disposed to receive a portion of the x-rays 27 from the anode 24. The monochromator has a crystallographic orientation and a concave configuration 35 to select and focus a beam of x-rays 36 in the desired energy band, e.g. the K-alpha line, as an x-ray spot 38 on the specimen surface 12 to be analyzed. The x-ray spot on the specimen is an image of the anode spot 26. The specimen 14 rests on a stage 40 that may have

orthogonal micrometer positioners 42 for manual or motorized positioning with respect to a support 44 in the instrument. See Column 5, line 36-46; and Column 6, line 11-22.

Larson (242) also discloses that the x-rays 36 cause photoelectrons 52 to be emitted from the active, scanning pixel area 48 of the specimen. The electron kinetic energies generally include a low energy peak in the range of up to 10 ev, usually about 2 to 5 ev, plus higher kinetic energy peaks or lines characteristic of chemical species (viz. chemical elements and/or their electron bondings) in the selected pixel area. With the rastering, characteristic higher energy photoelectrons vary with chemistry across the specimen surface, and the low energy electrons (commonly known as "secondary electrons") vary with topography as well. The photoelectron spectrum provides information on the surface at a selected pixel area or across the rastered array of areas. There also may be Auger electrons, which, for the present purpose, are included in the term "photoelectrons" as they are caused by the x-rays.

The scanning x-ray embodiment for topographical imaging or chemical mapping, or for summing of chemical information over the surface, is advantageous for specimens of electrically insulating material because the primary beam is neutral. Photoemission will cause the sample to charge positively and impede further emission, but this positive charging is readily neutralized by flooding the specimen with a with low energy electrons 100 (generally 1-10 eV and 0.1-10 .mu.A) from a flood gun 98 such as a Perkin-Elmer model 04-090 electron gun or the like. The low energy electrons will not be detected through an analyzer for chemical mapping. See Column 6, line 65-68; Column 7, line 1-12; and Column 12, line 1-12.

Therefore it would have been obvious to one of ordinary skill in the art that the imaging apparatus and method of Nishimura (781) can be modified to use low-energy electrons in accordance with Larson (242), to neutralize the surface charge on the sample due to photelectron emission.

Nishimura (781) in view of Larson (242) as applied above does not disclose the use of filtering to either, (a) select reflected electrons and reject photoelectrons, as recited in Claim 52; (b) select reflected electrons and reject secondary electrons, as recited in Claim 66 ; or (c) select secondary electrons and reject reflected electrons , as recited in Claim 61. However, Ose (357) discloses that device miniaturization has progressively advanced in the semiconductor industry in recent years, and optical microscopes for inspection in semiconductor device fabricating processes and test processes have been replaced by SEMs. The SEM uses an electron beam for dimension measurement and testing electrical operations. When observing an insulating specimen, such as a wafer that is used in the semiconductor industry, is observed with a SEM, a low acceleration voltage of 1 kV or below must be used not to charge the insulating specimen. Generally, the resolution of a general SEM using a low acceleration voltage of 1 kV is about 10 nm. As the miniaturization of semiconductor devices advances, demand for SEMs capable of forming images in a high resolution by using a low acceleration voltage has increased. See Paragraph [0003].

Ose (357) also discloses that the secondary signal electrons 2 are generated when the specimen 13 is irradiated with the primary electron beam 1. The secondary

signal electrons 2 include secondary electrons and reflected electrons. The electric field created in a space between the objective 10 and the specimen 13 acts as an acceleration electric field on the secondary signal electrons 2. Therefore, the secondary signal electrons 2 are attracted to the electron beam-passing aperture of the objective 10. The secondary signal electrons 2 travel upward being subjected to the focusing action of the magnetic field of the objective 10. The secondary signal electrons having high energy collide against a conversion electrode 16, whereby secondary electrons 3 are emitted. A positive high voltage of about 10 kV is applied to a scintillator 17. The scintillator 17 attracts (deflects) the secondary electrons 3 and emits light. A secondary electron detector, not shown, that detects secondary electrons guides the light emitted by the scintillator 17 by a light guide to a photomultiplier, the photomultiplier converts the light into a corresponding electric signal, the electric signal is amplified and the amplified electric signal is used for the brightness modulation of a CRT. See Paragraph [0026]

It is possible to prevent the secondary electrons from passing the central aperture of the conversion electrode 16 by disposing an energy filter 60 including a plurality of layers of meshes below the conversion electrode 16 with respect to the traveling direction of the primary electron beam, whereby energy discriminating ability is improved. In the SEM in this embodiment, a secondary electron detector, not shown, may be interposed between the energy filter 60 and the objective 10 to catch all the secondary electrons that collide against the meshes of the energy filter 60 and do not reach the conversion electrode 16. See Paragraph [0031]

Therefore it would have been obvious to one of ordinary skill in the art that the imaging apparatus and method of Nishimura (781) in view of Larson (242) can be modified to use the filtering apparatus and method of Ose (357), to improve image resolution and accuracy of dimensional measurement.

Nishimura (781) in view of Larson (242) also does not disclose the use of angular filtering as recited in Claims 56, and 67-69. Ose (357); however, also discloses that when there is not any retarding electric field or the retarding electric field is sufficiently small, only the reflected electrons pass the electron beam passing aperture of the objective 10. The reflected electrons have high energy. Positions at which the reflected electrons fall on the conversion electrode 16 are dependent on angle at which the electrons are reflected by the specimen 13 and energy of the reflected electrons. Therefore, information represented by the selected reflected electrons can be obtained in a high sensitivity by disposing an aperture filter 62 below the conversion electrode 16 with respect to the traveling direction of the primary electron beam. When the reflected electrons reflected in a substantially perpendicular direction are selected, an image of high contrast of a specimen having a specific atomic number can be observed in a high resolution. In the conventional SEM, the path of the reflected electrons and the path of the primary electrons overlap each other and hence the detection of the reflected electrons is difficult. See Paragraph [0032].

Therefore it would have been obvious to one of ordinary skill in the art that the imaging apparatus and method of Nishimura (781) in view of Larson (242) can also be

modified to use angular filtering in accordance with Ose (357), to further improve image contrast.

Conclusion

4. Any inquiry concerning this communication or earlier communications should be directed to Phillip Johnston whose telephone number is (703) 305-7022. The examiner can normally be reached on Monday-Friday from 7:30 am to 4:00 pm. If attempts to reach the examiner by telephone are unsuccessful, the examiners supervisor John Lee can be reached at (703) 308-4116. The fax phone numbers are (703) 872-9318 for regular response activity, and (703) 872-9319 for after-final responses. In addition the customer service fax number is (703) 872- 9317.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703 308 0956.

PJ

November 19, 2003

JOHN R. LEE
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2800